

Method for producing sliding materials

Field of application of the invention

The invention relates to a method for producing sliding materials in solid or composite design, which are used in particular for producing maintenance-free friction bearings or sliding elements.

Characteristics of the known technical solutions

A large number of methods using different lubricants have already been proposed for the purpose of improving the running qualities of bearing materials.

The best results have been achieved with the use of polytetrafluoroethylene (PTFE).

Although low coefficients of sliding friction are achieved through the application of compact PTFE coatings (DT-OS 1425 998), through the adhesion of a PTFE film or multiple sprayings of a PTFE dispersion, this method is technically and financially expensive, and the coatings are detached from the substrates again with higher mechanical and thermal stresses.

The adhesion (anchoring) of the PTFE is improved considerably by incorporating PTFE threads or fibers, preferably in the form of woven textiles or felted fabrics, into the surface of plastic bearings (DT-OS 1400 949, DT-OS 1569 057, DT-OS 1575 362, DT-OS 1629 417, DT-OS 1779 844, DT-OS 1922 520, DT-OS 1924 505, DT-OS 2140 917, DT-OS 2150 847, DT-OS 2302 641).

The methods for applying or incorporating PTFE onto or into surfaces can be used only with finally shaped bearings.

Friction bearing materials that are to be sawn or cut to an arbitrary bearing shape after curing require a uniform distribution of the PTFE throughout the entire material. For this purpose it was proposed to incorporate the PTFE in a granulated, powdered or, in the interest of a better anchoring, in fibrous form into a thermosetting casting resin matrix. The recommended PTFE materials (DT-AS 1295 808, DT-OS 1704 706, DD-PS 114 238, DT-PS 1260 234) have particle diameters of usually more than 350 μm . It was shown that the lubricant effect is not yet sufficiently homogeneous with the use of these very coarse particles as well as the fibers due to the inadequate dispersion of the PTFE over the bearing surface. Furthermore, the anchoring mechanism between the PTFE and the resin breaks down with higher stress.

Bearing capacity, abrasion resistance and homogeneity can be considerably improved through the use of fine polytetrafluoroethylene with particle sizes between 0.1 and 5 μm (DT-PS 2029 400, DT-OS 2264 132, GB-PS 974 629). The disadvantage of these methods is that due to the very organophobic properties of the PTFE, the fine powders are difficult to incorporate into the resin, the particles tend to agglomerate, the

distribution in the resin is not sufficiently homogeneous and good effectiveness is achieved only with amounts over 20%, preferably 25%, based on the substance mixture. These high amounts used are cost-intensive, and problems result in the dissipation of the frictional heat from the bearing due to the poor thermal conductivity of the PTFE. This solution is therefore suitable only for those bearings that have a relatively thin layer of the resin as a coating on a basis material with comparatively good thermal conductivity, such as steel, or that contain heat-conducting fillers, such as lead powder, bronze powder, white metal powder or graphite powder.

Object of the invention

The object of the invention is a method for producing sliding materials that contain a PTFE-based additive of this type, which has the necessary properties with respect to workability, compatibility with the resin components and homogeneous dispersion.

Essence of the invention

The object of the invention is to develop a method for producing sliding materials in which the PTFE-based additive is treated by suitable technological steps such that its sliding properties are brought to bear at lower concentrations than with conventional PTFE fine powders.

This is carried out according to the invention by the incorporation of a PTFE powder with functional groups during the production of the sliding material, which preferably comprises web-shaped carrier material impregnated with synthetic resins.

It was found that a PTFE fine powder produced by means of radiation chemistry in the presence of air, oxygen or additives, such as sulfites, carbonates, nitrites, nitrates, halogenides, cyanides, urea, amines, amino alcohols, alcohols, aldehydes or organic acids and optionally after subsequent milling is very suitable. The powder produced in this manner in the radiation field preferably of a gamma source or an electron accelerator from PTFE suspension polymer, PTFE emulsion polymer, PTFE off-specification batches, mechanical PTFE processing residue or radiation-chemically polymerized tetrafluoroethylene is technologically easily accessible and is free-flowing, in contrast to the base materials. For example, the average primary particle size is $3\text{ }\mu\text{m}$ in the case of the output of PTFE suspension polymer and less than $1\text{ }\mu\text{m}$ in the case of the output of PTFE emulsion polymer. Agglomerates of these primary particles are easily divisible. The functional groups provide an adequate compatibility of the otherwise organophobic perfluorocarbon with the resin component. The fine powders can therefore be incorporated well into the organic resin in a homogeneous fine distribution; there is no agglomerate formation in the resin.

The type of functional groups is determined by the selection of the substances added during the production of the fine powders. The adhesive properties of the particles can thus be modified. Groups are possible such as $-\text{COOH}$, $-\text{SO}_3\text{H}$, $-\text{CONH}_2$, $-\text{COOR}$, $-\text{COX}$, $-\text{OR}$, $-\text{CN}$, $-\text{X}$ (X = halogen, R = alkyl). The functional groups are located primarily on the particle surface, where they are also needed for coupling.

The incorporated PTFE particles are already able to fully develop their sliding properties with a relatively low concentration. Proportions of 5 to 15%, preferably 10%, based on the cured bearing material, are sufficient. With this low concentration the thermal

conductivity of the bearing material is not greatly impaired, either. The fineness and the good adhesive properties of the incorporated powders ensure a good wear behavior of the finished bearing materials.

For the production of phenolic resin laminated composites, it is advantageous to work the PTFE fine powder with functional groups first with a dispersing agent, a spreader and methanol and subsequently to incorporate the phenolic resin solution with a high-speed mixer. In this manner any agglomerates of the dry PTFE fine powder present are dispersed and a homogeneous stable dispersion is obtained. Subsequently the resin mixture is processed as usual with the impregnated carrier material to form a laminated composite and thermally cured.

The sliding materials thus produced are suitable for producing maintenance-free bearings. Their mechanical properties are very good. The coefficients of sliding friction are below 0.2. The slight wear can be reduced even further through additional lubrication.

For economic reasons it is advantageous to equip the slip zone with the material according to the invention and the support zone with conventional materials.

Exemplary embodiments

The invention is described in more detail below based on exemplary embodiments.

Example 1:

0.84 kg PTFE fine powder, produced by the irradiation of PTFE suspension polymer at room temperature and in the presence of air in the radiation field of a ^{60}Co gamma source with a dose of 20 Mrd, is worked with 0.23 kg of a nonionogenic dispersing agent, 0.16 kg of an anion-active dispersing agent and 0.46 kg methanol. This mixture is homogenized with 5.7 kg of a 65% phenolic resin solution in a high-speed mixer and processed with 3.7 kg cotton fabric or stitch-bonded material to form a laminated composite. The cured material contains 10% PTFE. The desired maintenance-free friction bearings are produced therefrom through mechanical processing.

Example 2:

40.5 PTFE fine powder, produced through irradiation of a 10 mm-thick layer of coagulate of a PTFE emulsion polymerization (off-specification batch) in homogeneous mixture with 8 kg ammonium sulfite in the radiation field of an electron accelerator (acceleration voltage 1000 kV, beam current strength 6 mA) up to a dose of 40 Mrd at a maximum of 120°C, washing out of the excess salt with an ethanol/water mixture (1:1) and subsequent milling with a pin mill, is worked with 24.5 kg nonionogenic dispersing agent, 16 kg anion-active dispersing agent and 41 kg methanol. This mixture is then processed with 609 kg of a 65% phenolic resin solution and 525 kg cotton fabric as with example 1 to form maintenance-free bearings. The bearing material contains 5% PTFE.

Claim

1. Method for producing sliding materials, which are preferably produced by pressing web-shaped carrier material impregnated with synthetic resins and contain a PTFE-based additive, characterized in that a PTFE fine powder with functional groups is incorporated during the production of the sliding material, wherein functional groups can be, for example, $-\text{COOH}$, $-\text{SO}_3\text{H}$, $-\text{CONH}_2$, $-\text{COOR}$, $-\text{COX}$, $-\text{OR}$, $-\text{CN}$, $-\text{X}$; wherein X = halogen and R = alkyl.
2. Method according to point 1, characterized in that the functional groups are bound to the PTFE by the irradiation of the PTFE powder with hard energetic radiation, preferably with a gamma source or an electron accelerator, in the presence of air, oxygen or additives, such as sulfites, carbonates, nitrites, nitrates, halogenides, cyanides, urea, amines, amino alcohols, alcohols, aldehydes or organic acids.
3. Method according to point 1 and 2, characterized in that the sliding material contains up to 20%, preferably 5 - 15% PTFE powder with functional groups.

Abstract

The invention relates to a method for producing maintenance-free friction bearings or sliding elements in solid or composite design. The sliding materials should thereby contain a PTFE-based additive, which has the necessary properties with respect to workability, compatibility with the resin components and homogeneous dispersion. This is carried out according to the invention in that a PTFE fine powder with functional groups is incorporated during the production of the sliding material, wherein the functional groups are incorporated by irradiation of the PTFE powder with hard energetic radiation.